Guest Editorial Photonic Networks and Devices

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GUEST EDITORIAL: Photonic Networks and Devices

As guest editors, we are pleased to introduce this Special Issue of the Journal of Lightwave Technology devoted to Photonic Networks and Devices. The special issue addresses the challenges and enabling technologies for high-performance optical networks, encompassing cutting-edge photonic devices, ultra-high capacity transmission systems, flexible and scalable network architecture, and cutting-edge network management paradigms leveraging on machine learning and SDN/NFV. It also serves as an archive of the key contributions presented at the OSA Photonic Networks and Devices (NETWORKS'18) meeting held at ETH Zurich in Switzerland, 2-5 July 2018, along with the distinguished papers accepted from an open call.

Unrelenting traffic growth combined with ever-stricter requirements on the performance of 5G network services continue to fuel the need for high-capacity, cost-efficient, agile, and resilient photonic devices and networks. In this respect, the research community has been proposing novel photonic devices and advanced probabilistic modulation formats, as well as adapting the network architecture and its operation and management policies. Future fiber optical transmission systems will make more efficient use of both spatial and spectral dimensions by using advanced multicore and multimode fibers as well as extending telecommunication wavelengths beyond the C and L bands. Additionally, free-space communications technologies will be employed in regions where it is difficult or impractical to install fiber. These new systems require additional components and devices such as optical crossconnects that can interface wavelength division multiplexed systems with the spatial dimension, together with power-efficient optical signal processing techniques in network nodes such as modulation format conversion operating directly in the optical domain.

Optical networks will continue to evolve in support of the stringent requirements of 5G network services. Integrated, proprietary systems are becoming more open and disaggregated to enable multi-vendor interoperability and maximize resource usage efficiency. Disaggregation can take place both inside data centers, where hybrid interconnect solutions deploying single- and multi-core fibers are investigated, as well as in the core/metro segment, by transitioning towards open line systems that require new software and hardware implementations of open, programmable network elements.

To carry the huge amount of network traffic in the transport segment and satisfy service performance requirements in a cost-effective way, optical network resources need to be optimized starting from the planning phase, and used efficiently during network operation even in the presence of diverse failures or variable physical layer conditions, including continuous system margin degradation due to device aging. To this end, network performance must be accurately monitored, so to reconfigure the network in response to dynamically, often unpredictably, changing conditions. The transition towards flexible, scalable and automated optical networks must be supported by network softwarization, virtualization of network functions and their efficient chaining across the network. In the face of growing network complexity, the application of machine learning techniques is becoming one of the key enablers of autonomous optical network operation. The

beneficial uses of machine learning demonstrated in this special issue include deep learning for accurate optical signal-to-noise (OSNR) estimation, latency-minimizing bandwidth allocation in the access segment, routing, modulation format and spectrum assignment (RMSA) policies for efficient resource usage, transfer learning for spectrum optimization in multi-core fiber-based networks, and supervised learning for diagnostics of physical-layer attacks. Moreover, this special issue features an encompassing invited tutorial on the application of machine learning for failure management in optical networks.

The special issue comprises 25 contributed papers, 5 invited papers and 1 invited tutorial. The published papers have been selected through a rigorous review process from a total of 66 manuscripts submitted by researchers from more than 26 countries. We are very grateful to Gabriella Bosco, Editor in Chief of the Journal of Lightwave Technology, as well as her predecessor Peter J. Winzer, for supporting us in organizing this special issue and for their guidance throughout its preparations. Special thanks go to Douglas Hargis, the publication administrator, for his invaluable help and technical support. We extend our gratitude to the expert reviewers for dedicating their time and expertise and providing detailed and constructive feedback on the manuscripts. We are also grateful to all the authors for contributing to this special issue by submitting their work in an outstanding quality and for their cooperation in meeting the publication schedule. Finally, we would also like to thank you, the readers of this special issue, for your interest. We hope that the issue captures the versatility of the most relevant research challenges in evolving optical networks and the variety of advanced theoretical and practical techniques for addressing them at different levels, thus deepening the general knowledge of the community, inspiring further development of novel, creative approaches, and above all also helps to stimulate your future R&D activities.